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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/815,976	04/02/2004	Atsushi Fukui	BJS-900-495	7726
23117 7590 06/16/2008 NIXON & VANDERHYE, PC 901 NORTH GLEBE ROAD, 11TH FLOOR ARLINGTON, VA 22203				
EXAMINER				
TRINH, THANH TRUC				
ART UNIT		PAPER NUMBER		
1795				
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06/16/2008		PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/815,976

**Applicant(s)**

FUKUI ET AL.

**Examiner**

THANH-TRUC TRINH

**Art Unit**

1795

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 28 May 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1, 2 and 21-38 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2 and 21-38 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-8508)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 5/28/2008 has been entered.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 21-25, 28-32 and 35 are rejected under 35 U.S.C. 102(b) as being anticipated by Lupo et al. (US Patent 5885368)

Regarding claims 21-25 and 28-32, as seen in Figure 1, Lupo et al. disclose a dye-sensitized solar cell comprising a transparent conductive layer (11), a porous semiconductor of titanium oxide (12) on which a dye sensitizer is adsorbed, a carrier transport layer (14) and an counter electrode (15) which are formed in this order on a transparent substrate (16). (See col. 2 lines 30-57). The dye sensitizer is made of metal

complex dye such as cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylate)-ruthenium(II) (See formula VIII). Lupo et al. also describe that the absorbance peak of the porous semiconductor layer after being rinsed with ethanol and dried in a warm air stream is 500 nm. (See col. 26 lines 58-67 bridging col. 27 lines 1-3, or col. 27 lines 40-52). Therefore it is the Examiner's position that the absorbance peak of the porous semiconductor of Lupo et al. is located on a shorter wavelength side of the absorbance spectrum than that of the porous semiconductor layer observed immediately after the dye sensitizer is adsorbed, as indicated from Applicant's disclosure that this characteristic is a result of a thermal treatment (See Specification, page 13).

In regards to claims 28 and 35, the claim limitations describing the chemical treatment of the porous semiconductor by immersing the porous semiconductor layer in a solution of at least 30 times as much as that of the porous semiconductor layer by volume and containing at least one heteroatom-containing cycle compound, and the time lapse for chemical treatment are process limitations that do not further define the structure of the device and thus are not given weight in the apparatus claim. See MPEP 2113.

2. Claims 21-25, 28-32 and 35-37 are rejected under 35 U.S.C. 102(b) as being anticipated by Yoshikawa (PGPub 20020040728)

Regarding claims 21-25, 28-32 and 35-37, as seen in Figure 1, Yoshikawa discloses a dye-sensitized solar cell comprising a transparent conductive layer (10), a porous semiconductor of titanium oxide (20) on which a dye sensitizer (22) is adsorbed,

a carrier transport layer (30) and an counter electrode (40) which are formed in this order on a transparent substrate (50). (See paragraphs [0069] and [0074]-[0111]). Yoshikawa also teaches the dye sensitizer is made of metal complex dye such as cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium (II). (See formula III and R-1 in paragraph [0111]), or organic dye (See formula M-3 in page 14). Yoshikawa further teaches the dye-sensitized semiconductor is subjected to a chemical treatment with heteroatom-containing compounds such as tetrahydrofuran, imidazole, etc., to improve the efficiency, (See paragraphs [0027]-[0067]), therefore it is the Examiner's position that the absorbance peak of the porous semiconductor of Yoshikawa is located on a shorter wavelength side of the absorbance spectrum than that of the porous semiconductor layer observed immediately after the dye sensitizer is adsorbed, as indicated from Applicant's disclosure that this characteristic is a result of a chemical treatment (See Specification, pages 13-15). Since Yoshikawa teaches all the structural limitation and material limitations of the claims, even the chemical treatment with heteroatom-containing compounds, therefore it is the Examiner's position that the absorbance peak of the porous semiconductor is inherently located within the range of 500 nm  $\pm$  30 nm.

In regards to claims 28 and 35, the claim limitations describing the chemical treatment of the porous semiconductor by immersing the porous semiconductor layer in a solution of at least 30 times as much as that of the porous semiconductor layer by volume and containing at least one heteroatom-containing cycle compound, and the time lapse for chemical treatment are process limitations that do not further define the

structure of the device and thus are not given weight in the apparatus claim. See MPEP 2113.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
  2. Ascertaining the differences between the prior art and the claims at issue.
  3. Resolving the level of ordinary skill in the pertinent art.
  4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
3. Claims 1-2, 26-27, 33-34 and 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lupo et al. (US Patent 5885368) in view of Andriessen et al. (WO 2004/025748).

Regarding claims 1 and 2, as seen in Figure 1, Lupo et al. teaches a dye-sensitized solar cell comprising a transparent conductive layer (11), a porous semiconductor of titanium oxide (12) on which a dye sensitizer is adsorbed, a carrier transport layer (14) and an counter electrode (15) which are formed in this order on a transparent substrate (16). (See col. 2 lines 30-57). Lupo et al. also teaches dye

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sensitizer is made of metal complex dye such as cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylate)-ruthenium(II) (See formular VIII). Lupo et al. further teaches the semiconductor layer is subjected to a warm air treatment (See col. 26 lines 58-67 bridging col. 27 lines 1-3, or col. 27 lines 40-52). Therefore it is the Examiner's position that the absorbance peak of the porous semiconductor of Lupo et al. is located on a shorter wavelength side of the absorbance spectrum than that of the porous semiconductor layer observed immediately after the dye sensitizer is adsorbed, as indicated from Applicant's disclosure that this characteristic is a result of a thermal treatment (See Specification, page 13).

Lupo et al. does not explicitly teaches the dye sensitizer is made of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium, or tris(isothiocyanato)-ruthenium(II)-2,2':6',2"-terpyridine-4,3',4"-tricarboxylic acid, tris-tetrabutylammonium salt.

Andriessen et al. disclose the dye sensitizer is made of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium. (See table on page 18).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Lupo et al. by using the dye sensitizer of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium as taught by Andriessen et al., because Andriessen et al. teaches that it would allow a broad absorption. (See page 17 of Andriessen et al.). In such

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combination, the absorbance peak of the porous semiconductor layer is obviously located within the range of  $490\text{ nm} \pm 35\text{nm}$ .

Regarding claims 26-27 and 33-34, Lupo et al. teaches a dye sensitized solar cell as applied to claims 21-25, 28-32 and 35.

Lupo et al. does not explicitly teaches the dye sensitizer is made of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium, or tris(isothiocyanato)-ruthenium(II)-2,2':6',2"-terpyridine-4,3',4"-tricarboxylic acid, tris-tetrabutylammonium salt.

Andriessen et al. disclose the dye sensitizer is made of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium. (See table on page 18).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Lupo et al. by using the dye sensitizer of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium as taught by Andriessen et al., because Andriessen et al. teaches that it would allow a broad absorption. (See page 17 of Andriessen et al.). In such a combination, the absorbance peak of the porous semiconductor layer is obviously located within the range of  $490\text{ nm} \pm 35\text{nm}$ .

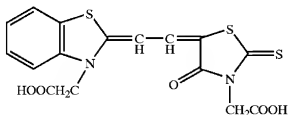
Regarding claims 36-38, as seen in Figure 1, Lupo et al. teaches a dye-sensitized solar cell comprising a transparent conductive layer (11), a porous



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semiconductor of titanium oxide (12) on which a dye sensitizer is adsorbed, a carrier transport layer (14) and an counter electrode (15) which are formed in this order on a transparent substrate (16). (See col. 2 lines 30-57). Lupo et al. also teaches the semiconductor layer is subjected to a warm air treatment (See col. 26 lines 58-67 bridging col. 27 lines 1-3, or col. 27 lines 40-52). Therefore it is the Examiner's position that the absorbance peak of the porous semiconductor of Lupo et al. is located on a shorter wavelength side of the absorbance spectrum than that of the porous semiconductor layer observed immediately after the dye sensitizer is adsorbed, as indicated from Applicant's disclosure that this characteristic is a result of a thermal treatment (See Specification, page 13).

Lupo et al. does not specifically teach the dye sensitizer is an organic dye such as



Andriessen et al. teaches using organic dyes (SSOD) having the same ring structure as the ring structure above with varying substituents. (See formula of SSOD organic dye on pages 16-17)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Lupo et al. by using the organic dye sensitizer as taught by Andriessen et al., because Andriessen et al. teaches that these organic dyes are suitable spectrally sensitizing dyes. (See page 16 of Andriessen et al.).

In addition, compounds which are homologs are generally of sufficiently close structural similarity that there is a presumed expectation that such compounds possess similar properties. (See MPEP 2144.09)

4. Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa (PGPub 20020040728) in view of Andriessen et al. (WO 2004/025748).

As seen in Figure 1, Yoshikawa discloses a dye-sensitized solar cell comprising a transparent conductive layer (10), a porous semiconductor of titanium oxide (20) on which a dye sensitizer (22) is adsorbed, a carrier transport layer (30) and an counter electrode (40) which are formed in this order on a transparent substrate (50). (See paragraphs [0069] and [0074]-[0111]). Yoshikawa also teaches the dye sensitizer is made of metal complex dye such as cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium (II). (See formula III and R-1 in paragraph [0111]), or organic dye (See formula M-3 in page 14). Yoshikawa further teaches the dye-sensitized semiconductor is subjected to a chemical treatment with heteroatom-containing compounds such as tetrahydrofuran, imidazole, etc., to improve the efficiency, (See paragraphs [0027]-[0067]), therefore it is the Examiner's position that the absorbance peak of the porous semiconductor of Yoshikawa is located on a shorter wavelength side of the absorbance spectrum than that of the porous semiconductor layer observed immediately after the dye sensitizer is adsorbed, as indicated from Applicant's disclosure that this characteristic is a result of a chemical treatment (See Specification, pages 13-15). Since Yoshikawa teaches all the structural limitation and material

limitations of the claims, even the chemical treatment with heteroatom-containing compounds, therefore it is the Examiner's position that the absorbance peak of the porous semiconductor is inherently located within the range of 500 nm  $\pm$  30 nm.

Yoshikawa discloses the general formula of ruthenium dye sensitizer, but does not specifically list out cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium or tris(isothiocyanato)-ruthenium(II)-2,2':6',2''-terpyridine-4,3',4''-tricarboxylic acid, tris-tetrabutylammonium salt.

Andriessen et al. disclose the dye sensitizer is made of cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II)bis-tetrabutylammonium. (See table on page 18).

In regards to formula (1), Applicant's disclosure states that the formula is of Ruthenium 620-1H3TBA commercialized by Solaronix, Swiss (Specification, Page 12 paragraph 2). Andriessen et al. teach using Ruthenium 620 as a dye sensitizer in solar cell (see table on page 18 of Andriessen et al.). Also, a MSDS of Ruthenium 620-1H3TBA from Solaronix is provided to support the fact that this compound has been commercialized before the time the invention was made. Thus, the Examiner considers the reference teaches the instant limitation.

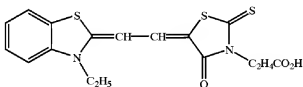
It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Yoshikawa by applying dye sensitizers as taught by Andriessen et al., because it would allow a broad absorption. (See page 17 of Andriessen et al). In such combination, the absorbance peak of the porous

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semiconductor layer is inherently located within the range of  $490 \text{ nm} \pm 35 \text{ nm}$ , or  $580 \text{ nm} \pm 35 \text{ nm}$ .

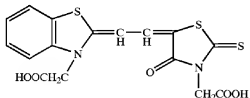
5. Claims 26-27, 33-34 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa (PGPub 20020040728).

Yoshikawa teaches a dye sensitized solar cell as applied to claims 21-25, 28-32 and 35-37. Yoshikawa also teaches using organic dye such as



(See formula M-3 on page 14 of Yoshikawa).

It would have been obvious to one skill in the art at the time the invention was made to modify the device of Yoshikawa by using the organic dye as shown in the instant claims,



because these two structures are homologs which are generally of sufficiently close structural similarity and used for the same purpose (dye sensitizer) that there is a presumed expectation that such compounds possess similar properties (See MPEP 2144.09).

***Response to Arguments***

Applicant's arguments with respect to claims 1-10 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh-Truc Trinh whose telephone number is 571-272-6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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/PATRICK RYAN/

Supervisory Patent Examiner, Art Unit 1795